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(54) Measuring carbon dioxide emissions from soil

(57) A device for measuring CO_2 emissions from e.g. soil samples as a measure of the biological activity of the sample has a chamber 12 for the soil 21 and a smaller chamber 13 containing a colorimetric indicator 22. The chambers are isolated from the ambient atmosphere. A colour reference chart 16 is compared with the colour obtained in the indicator.

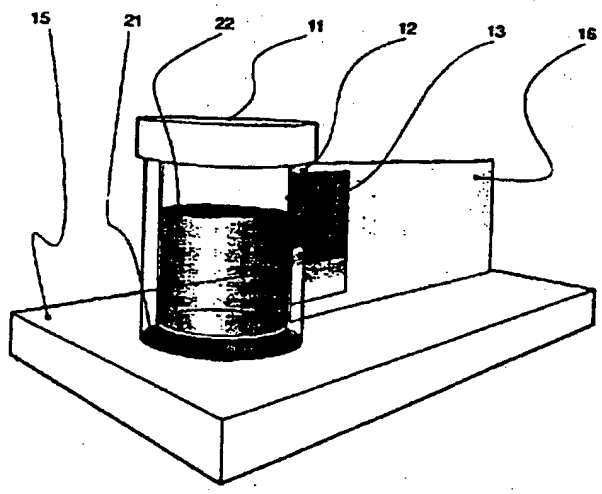

Figure 1

GB 2 319 837 A

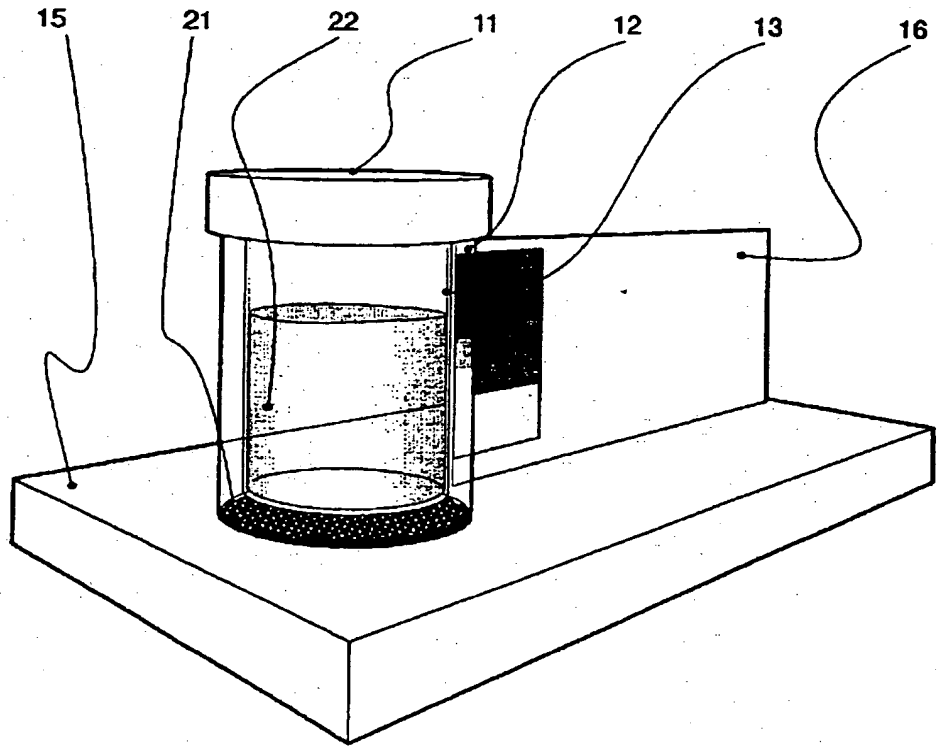

Figure 1

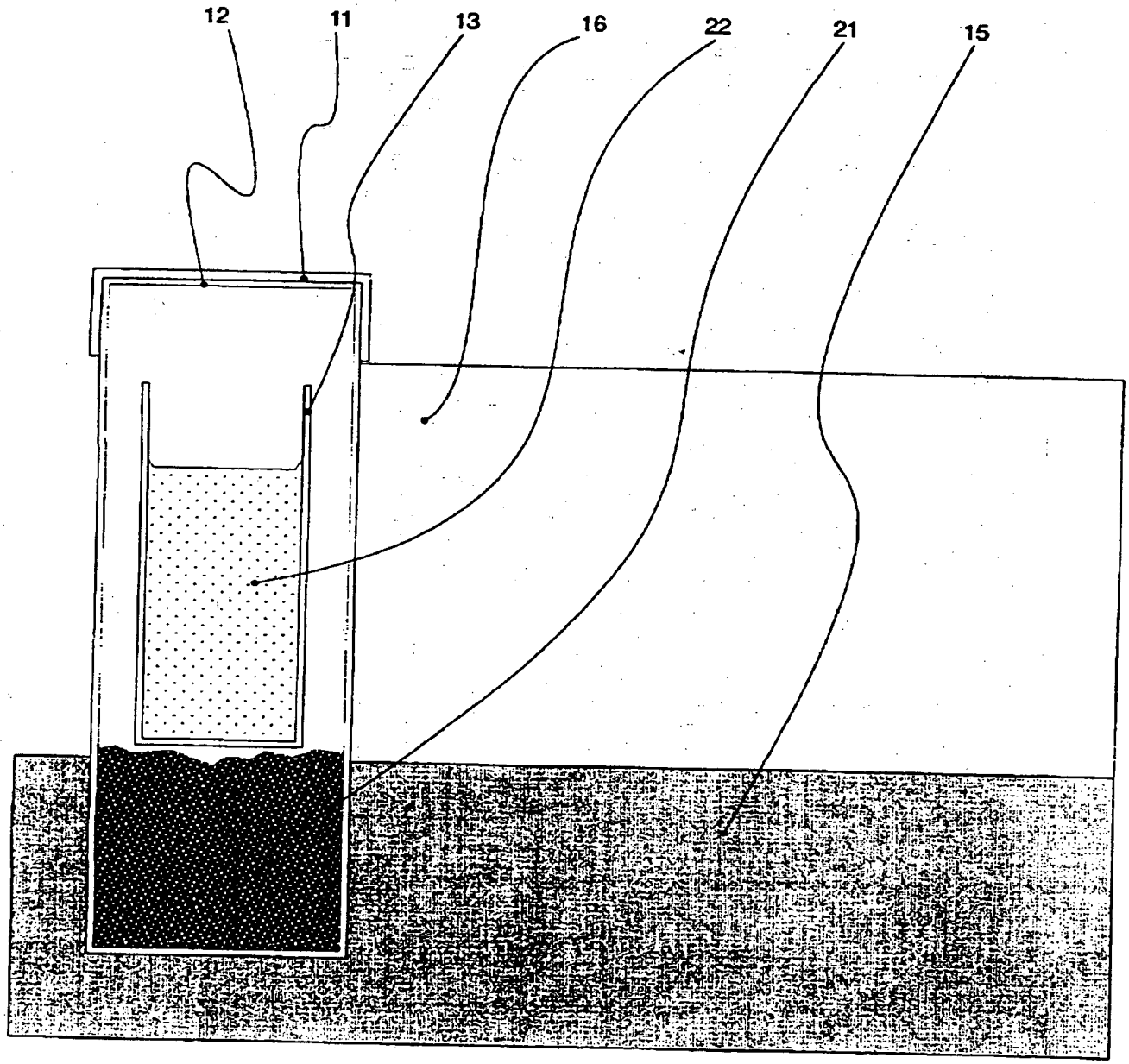

Figure 2

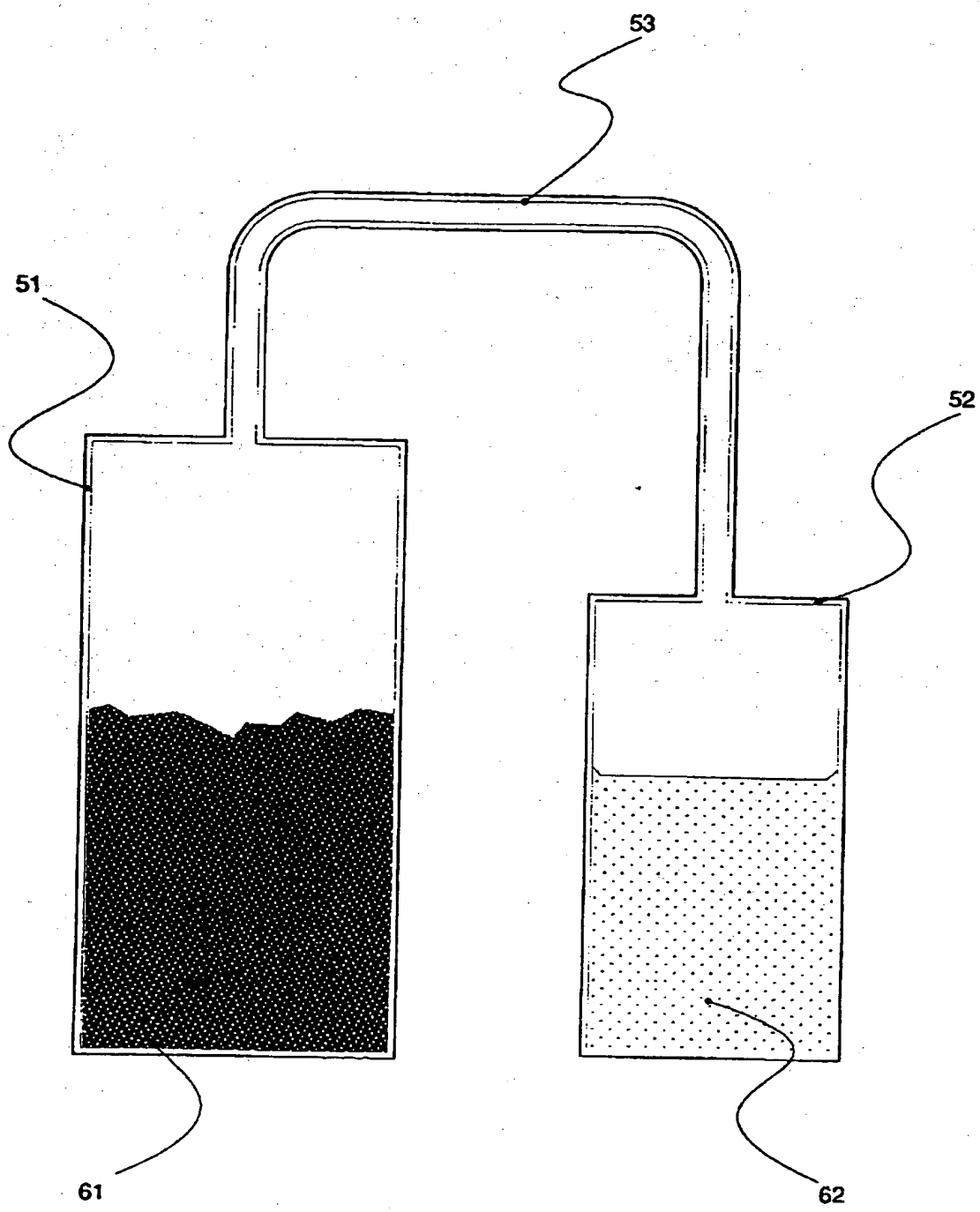

Figure 3

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Soil Biological Activity Testing

This invention relates to the measurement of biological activity in a sample, such as soil, and is particularly, but not exclusively, concerned with the use of carbon dioxide emission measurement as an indicator of such biological activity.

Soil comprises a mixture of inorganic and organic matter, and soils vary considerably in their composition.

The inorganic portion of soil is generally composed of silicates of various metals, mainly of aluminium, but also of iron, calcium, magnesium, etc., sand and other inorganic matter, depending on the source.

Much of the organic matter in soil is in the form of humus. Humus is the result of animal and vegetable decomposition and is rich in bacteria, fungi, microarthropods and other organisms. It also improves cation absorption and exchange, assists in formation of soil structure and prevents leaching of important ions. Humus can therefore act as a reservoir of minerals for plant uptake,

Plants growing in soil need the minerals and nutrients found in the soil in order to build cell tissue for growth - extracting them in solution from the soil through their roots.

The nutrient and mineral content of the soil is thus an important factor in the value of the soil as a growth medium for plants.

It is common practice to enhance the 'quality' of the soil by adding nutrients and minerals as organic and inorganic materials.

The biological activity in the soil - ie the presence of the bacteria, fungi and other living organisms - is also an important factor in the 'quality' of the soil. If the soil is 'dead' then it will not act as an adequate growth medium for plants.

Through their biological (biochemical) activity, these organisms respire, releasing carbon dioxide.

Overall, the biological activity is proportional to the amount of carbon dioxide emitted by the soil

Measurement of this emission provides a basis for assessing the biological activity of the soil.

Several indicator substances are known which react to chemical changes brought about by, and so can indicate the presence of, dissolved carbon dioxide - for example, by changing colour in response to pH.

It is known to use such indicators to measure the biological activity in a given soil sample. However, at present the only tests available for the biological activity of soil samples are laboratory-based, and so the sample must be sent to a laboratory for testing.

In such laboratory tests, the sample is kept in a sealed container. The gas in the container is then drawn off (using a syringe or comparable extraction method) and is injected into an indicator solution which will react to the presence of carbon dioxide in the gas.

Alternatively, the carbon dioxide is directly absorbed into strong alkali in the container and the amount of carbon dioxide is determined by titration.

Such tests are an accurate guide to the level of biological activity in a soil sample.

However, this manner of testing does have several disadvantages.

Firstly, the test procedure requires a certain amount of technical skill.

Secondly, the complete removal of carbon dioxide from the atmosphere by strong alkali may disturb the biological activity in the sample.

Additionally, the testing is time-consuming and costly because it must be carried out off-site in a laboratory.

Some aspects of the present invention are concerned with a simple 'in-the-field' test for measuring the biological activity in terms of carbon dioxide emissions.

This test can be carried out by an unskilled operator in diverse soil sites - from a commercial agricultural field to a domestic garden.

The aim of the invention is to provide a simple and rapid test, which gives a clear and easily interpreted result.

The test is based upon laboratory test principles, but with a greatly simplified test technique.

According to one aspect of the invention, a soil sample is loaded into a sample chamber. This sample chamber is linked to the indicator chamber into which the indicator is introduced. Transfer of air between the two chambers is allowed, but the whole system is closed, so that there is no exchange of air between the two chambers and the outside.

This link between the chambers means that any carbon dioxide emitted by the soil sample is therefore released into the air in both chambers, and thus comes into contact with the indicator.

The indicator solution is chosen so that, when exposed to carbon dioxide, it will change colour - but will not deplete the carbon dioxide in the air. The resultant colour will be an indication of the amount of carbon dioxide in the air.

In order to obtain an accurate result, and one which will reflect the biological activity of the soil sample, firstly the sample must be of a prescribed size. A larger sample will emit more carbon dioxide than a smaller sample with the same biological activity.

Secondly, the test must be conducted for a predetermined period of time. The longer a sample is tested, the more carbon dioxide will be emitted, and thus variable test time would otherwise distort the test results.

Thirdly, the test must be conducted at a given temperature. The higher the temperature, the more carbon dioxide will be emitted. Again, temperature variation would distort the test results.

According to another aspect of the invention, a soil test is conducted and the resultant colour of the indicator is compared with a bespoke colour chart, which will show the biological activity of the soil sample provided that the sample emitted carbon dioxide to change the indicator to that colour.

There now follows a description of a particular embodiment of the invention, by way of example only, with reference to, and as shown in, the accompanying diagrammatic and schematic drawings, in which:

Figure 1 shows a test kit;

Figure 2 shows a cross-sectional view of the test kit illustrated in Figure 1; and

Figure 3 shows an alternative arrangement of the sample and indicator chambers.

Referring to the drawings, a soil test kit comprises a large vial 12 with lid 11, and a smaller vial 13. A colour chart 16 is provided for interpreting the resultant colour of the indicator.

The test kit is packaged in a container or box 15, which also acts as a stand to support and protect the chambers while the test is being carried out.

The larger vial 12 is the sample chamber and the soil sample 21 is put into the bottom. A marking (not shown) on the side of the vial 12 indicates the required amount of soil.

The smaller vial 13 is the indicator chamber. The indicator 22 is either provided in this vial, or it is transferred from another source to the vial for the purpose of the test.

The smaller vial 13, with the indicator substance 22, is then placed inside the larger vial 12, and on top of the soil sample 21.

The lid 11 of the larger vial 12 is then replaced.

The test is subsequently left for a fixed period at a given temperature, after which the colour of the indicator substance 22 is compared with colour gradations on a reference chart 16. These reaction colour will reflect a given level of biological activity of the sample 21.

In an alternative embodiment, as illustrated in Figure 3, the sample chamber 51 and indicator chamber 52 are joined by tube or passage 53. This allows any carbon dioxide emitted by the soil sample 61 to come into contact with the indicator 62.

Component List

11	lid
12	large vial / sample chamber
13	smaller vial / indicator chamber
15	container / box
16	colour chart
21	soil sample
22	indicator substance
51	sample chamber
52	indicator chamber
53	(air) passage
61	soil sample
62	indicator substance

Claims

1.

A (soil) tester,
for measuring carbon dioxide emission
of a sample of biological material, such as soil,
the tester comprising a sample chamber
for a sample of a prescribed size
and an indicator chamber,
for an indicator which changes colour
according to the proportions of gases
in the chamber, and
as a result of the respiratory activity of the sample material,
said sample and indicator chambers
being linked to allow air flow between them,
but not with the outside atmosphere,
and a colour reference chart,
with colour gradations,
for comparison with the reaction colour of said indicator substance
after a fixed test period,
at a given temperature,
to indicate the biological activity of the sample.

2.

A tester
as claimed in any of the preceding claims,
incorporating markings on the sample chamber to indicate
the volume of sample material required for the test.

3.

A tester
as claimed in any of the preceding claims,
including a container which also serves as a stand
for the test sample chamber during testing.

4.

A soil test method,
using a soil tester as claimed in any of the preceding claims,
in which the indicator chamber is opened
and placed inside the sample chamber,
together with the sample,
and the sample chamber is sealed with a lid.

5.

A soil test method
as claimed in Claim 4,
in which the indicator changes colour
in proportion to its exposure to carbon dioxide
produced by respiratory activity in the sample.

6.

A soil test method
as claimed in Claims 4 or 5,
wherein the indicator changes colour
in proportion to level of oxygen
consumed by respiratory activity in the sample.

7.

A soil test method
as claimed in Claims 4, 5 or 6,
utilising a bicarbonate salt and a colorimetric indicator.

8.

A test kit
substantially as hereinbefore described
with reference to the accompanying Figure 1.

The Patent Office

Application No: GB 9624740.8
Claims searched: 1 - 8

Examiner: Michael R. Wendt
Date of search: 26 January 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G1B (BAA, BBE)

Int Cl (Ed.6): G01N 31/22, 33/24

Other: Online: WPI, Claims, Japio

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	WO 96/36875 A1	(TEMPLETON) e.g. see Figure 3 & Claim 1, Abstract.	1
A	WO 93/15402 A1	(HOLTE) e.g. see page 1 lines 4 etc. Page 19 at lines 33 etc. Page 21 lines 15 etc. Figures 7 & 10.	1
X	US 5320807	(BRINTON) e.g. see Column 5 lines 59 - 61. Column 7 lines 47 etc. Claims. Figures 1 & 2.	1, 2, 4 & 8

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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P Document published on or after the declared priority date but before the filing date of this invention.
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